ENVIRONMENTAL ASSESSMENT

WILDLIFE HAZARD MANAGEMENT AT

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT HEALTH INSPECTION SERVICE ANIMAL DAMAGE CONTROL

December 20, 1996

1. Introduction

The U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control program (APHIS-ADC) is directed by law to protect American agriculture and other resources from damage associated with wildlife. The primary authority for the APHIS-ADC program is the Animal Damage Control Act of March 2, 1931, as amended (46 Stat. 1468; 7 U.S.C. 426-426b and 426c). In 1988, Congress strengthened the legislative mandate of APHIS-ADC with the Rural Development, Agriculture, and Related Agencies Appropriations Act (P.L. 100-202) which authorizes the Secretary of Agriculture to enter into agreements to control nuisance mammals and birds.

Wildlife damage management, or control, is defined as the alleviation of damage or other problems caused by or related to wildlife. The APHIS-ADC program uses an Integrated Pest Management (IPM) approach in which a variety of methods may be used or recommended to prevent or reduce wildlife damage. IPM is described in Appendix J of APHIS-ADC Program Final Environmental Impact Statement (EIS) (USDA 1994).

The APHIS-ADC program provides an integrated wildlife control program at a provide on the island of Hawaii and surrounding areas to reduce the bird strike hazards to aircraft. Lethal methods include shooting and trapping introduced bird species on the airfield and at key roost and rookery locations. Nonlethal bird strike prevention techniques include trapping and relocation, hazing using pyrotechnics, driving, walking, flushing (for all species but especially endangered species, as permitted), and decoying birds from high risk areas.

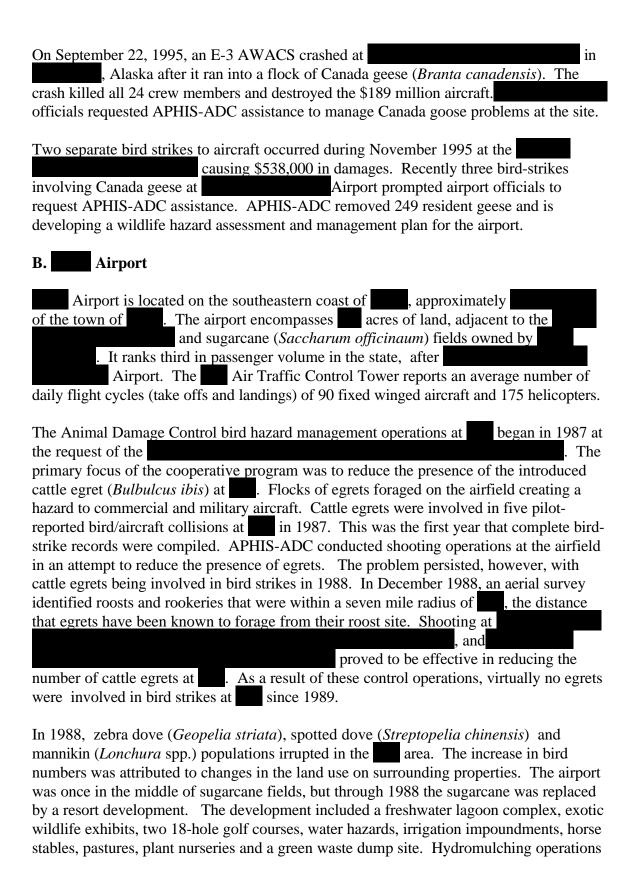
The objective of the APHIS-ADC operation at is to reduce bird-strikes through technical assistance and lethal and nonlethal control methods, thereby protecting human lives and property through an integrated wildlife hazard management program.

2. Purpose and Need

A. Aviation Wildlife Conflicts - General

Wildlife-aircraft strike hazards are a major concern for aviation in the United States, costing the airline industry and the military about \$250 million annually and threatening the lives of passengers and crews. The threats to human safety and the damage caused to aircraft by wildlife at airports requires that wildlife management on and around airports be an integral part of airport safety and management.

The Federal Aviation Administration (FAA) reported 2,220 bird and mammal strikes in the United States in 1994. A total of 517 of these incidences including 118 incidences of strikes to the engine resulted in damage. Waterfowl, birds of prey and crows cause the highest ratio of damage per strike. In 1994, the FAA reported a total amount of 488 aircraft components damaged by wildlife strikes. Engines are most readily damaged followed by wings, nose, windshield, and landing gear (Dolbeer 1995, Linnell et. al. 1996).

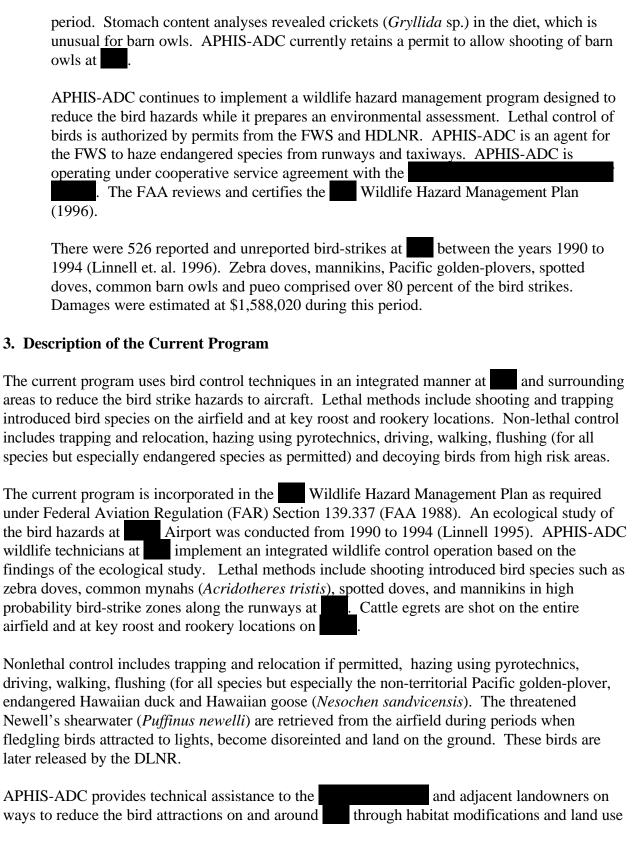


were attributed to the irruption in the zebra and spotted dove populations. The birds were also attracted to seeds produced by Henry's crabgrass (*Digitaria adscendens*) and various other grass and forb species that grew on the airfield. Shooting was employed as a short term remedy to reduce the presence of seed-eating bird species, but was not considered effective in eliminating the bird strike incidents. Long term remedies were sought with experiments involving the evaluation of long grass and alternative ground covers. Wedelia (*Wedelia trilobata*) was evaluated as an alternative ground cover from 1993 to 1994 and proved to attract significantly less bird use than the grassed areas (Linnell 1995).

The endangered Hawaiian duck (*Anas wyvilliana*) population increased substantially during 1988-1989, as a result of increased habitat provided by the waterways of the and the irrigation and dust control ponds fed by the sewage treatment facility used during the reconstruction of Runway 3. In 1989, airline pilots reported three bird strikes involving the duck at APHIS-ADC sought the advice and consultation of biologists with U.S. Fish and Wildlife Service (USFWS) and the Department of Land and Natural Resources (HDLNR). Trapping and relocating ducks was attempted without success. Careful observations of duck movements revealed a tendency for ducks to cross Runway 3 from the resort after rains filled the abandoned sugarcane drainage ditches on the seaward side of the runway. Current operations involve hazing ducks from the ditches after rain water begins to collect and installing mylar tape as an exclusionary measure.

Pacific golden-plovers (*Pluvialis fulva*) made up about 15 percent of the total bird strikes at Shooting was conducted on territorial individuals along the runways from December 1989 to May 1991. Lethal control ended in the spring of 1991 after some public concern. Shooting was found to be ineffective in alleviating the bird strike hazards caused by plovers. Most of the bird strikes that involved plovers occurred in October when juvenile birds arrived for the winter. Sixty percent of all plover bird strike records occur during this period and involve juveniles. Hazing with pyrotechnics and propane cannons are currently the principal methods of chasing juvenile plovers from runways. There is no control of territorial individuals.

On March 14, 1992, an Aloha Airlines B-737 ingested a common barn owl (*Tyto alba*) on take-off resulting in an aborted flight due to the destruction of one of its engines. The estimated cost to replace the engine was about \$800,000. An unusually high number of owls were present at the airfield from March to April 1992. Approximately four owls are normally observed at _____, but as many as 19 barn owls and three pueo (*Asio flammeus sandwichensis*) were counted on a single day of March 31, 1992. APHIS-ADC requested assistance from the Hawaii Department of Health, Vector Control Branch to evaluate the rodent population at the airport. Their assessment showed a virtual absence of rodents on the airfield compared to adjacent fields on the surrounding private property (Tangalin and Jamieson 1992). APHIS-ADC subsequently requested authority to shoot the introduced owls and capture and relocate the pueo to alleviate the bird hazards during this unusual



changes. APHIS-ADC has made recommendations to airport management on habitat alterations to reduce attractant vegetative cover on the airfield. The existing vegetation attracts seed-eating birds. The airport manager is in the process of replacing existing cover in critical areas with wedelia that is not highly attractive to seed-eating birds. The project will take a number of years to complete since planting is restricted to wet months and when plant propagules can be obtained. While APHIS-ADC has no control over the implementation of any technical assistance recommendations by the airport or any other landowner, the implementation of the recommendations are considered essential to the IPM and the successful reduction of wildlife hazards at the especially when considering long-term solutions.

APHIS-ADC technicians also compile bird-strike records and retrieve all bird carcasses for identification and post-mortem determination of a bird-strike incident. APHIS-ADC technicians, under the guidance of a trained wildlife biologist, monitor bird populations to predict high hazard periods and evaluate the effectiveness of bird control measures.

4. Public Involvement and Issues Identification

APHIS-ADC used the information gathered from its interdisciplinary team of specialists within the agency, the FWS, DLNR, and from airport personnel to identify potential issues. The following issues have been determined to be important to this environmental analysis; impacts on federally listed threatened and endangered species; impacts on target and nontarget species, animal welfare, impacts on migratory birds; and effectiveness (avoiding bird strikes and thereby reducing threats to human safety and economic losses), noise impacts from propane cannons, and costs of funding the APHIS-ADC program.

5. Alternatives

The following alternatives (options) that could be implemented by APHIS-ADC at discussed below (Table 1). The wildlife hazard management methods that would be allowed under each alternative include lethal and nonlethal methods such as hazing, shooting, live trapping, habitat and structure management, flexible staffing of personnel, and surveying and monitoring.

A. Current Program (No Action Alternative)

The "No Action" alternative is the current program and the prefered alternative. This is composed of the Wildlife Hazard Management Plan, the current bird control measures, monitoring and technical assistance recommendations for habitat modifications. The current program is being conducted to safeguard immediate threats to human safety, and to assist in complying with FAA regulations.

B. No APHIS-ADC Control

Alternative B would allow APHIS-ADC to provide only technical assistance to the airport. Under this alternative, APHIS-ADC would make recommendations to airport manager on effective lethal and nonlethal control methods to reduce wildlife hazards. Lethal control methods such as shooting and non-lethal hazing and capturing techniques would be demonstrated to airport personnel. Under this alternative wildlife control activities could be undertaken by the airport directly or through a contracted agent.

If funded, APHIS-ADC would continue to provide current levels of technical assistance recommendations regarding modifications to airport property including replacing attractant vegetation to reduce wildlife habitat. APHIS-ADC, while providing technical assistance, has no authority to ensure that recommendations are carried out by the airport or their contracting agents.

Table. 1. Comparison of the alternatives

Management Method	Alt. A Current Program	Alt. B No APHIS-ADC Control
Hazing	yes	no
Shooting (lethal)	yes	no
Live Trapping	yes	no
Survey and Monitor	yes	yes
Habitat/Structure Management	yes	no
Flexible Staffing of Personnel	yes	no

6. Environmental Consequences

The APHIS-ADC program evaluated the environmental consequences of the management alternatives in the programmatic EIS. In the development of this environmental assessment (EA), issues concerning biological, economic, sociocultural, and physical impacts were identified for evaluation. Each alternative is examined against the issues identified in the environmental assessment process.

A. Current Program

<u>Impacts on Threatened and Endangered Species</u>

No significant impacts on other state or federally listed threatened or endangered species would occur from implementing the current program.

<u>Impacts on Target Species</u>

The impact of the program on target species during a typical one-year period is the lethal removal of 237 cattle egrets, 11 common barn owls, 1,783 spotted doves, 13,735 zebra doves, three feral pigeons (*Columba livia*), 330 house sparrows (*Passer domesticus*), 5,853 mannikins and 522 common mynah, 68 ring-necked pheasants (*Phasianus colchicus*), 277 house mice (*Mus musculus*), 24 feral cats (*Felis catus*), and one dog (*Canis familiaris*) (MIS, April 1, 1993 to March 31, 1994). These numbers are not significant on the overall population of any of these introduced species because of the high reproductive and recruitment rates.

Impacts on Animal Welfare

Animal welfare will be described in terms of humaneness for this EA. The issue of humaneness, as it relates to the killing or capturing of wildlife is an important but very complex concept that can be interpreted in a variety of ways. Humaneness is a person's perception of harm or pain inflicted on an animal, and people may perceive the humaneness of an action differently. Some individuals and groups are opposed to some of the management actions of APHIS-ADC, especially lethal methods. However, because

serious safety hazards can occur from wildlife at the airport, it is concluded that the most effective and expeditious methods must be used to handle wildlife conflicts. APHIS-ADC personnel are experienced and professional in their use of management methods so that they are as humane as possible.

Impacts on Migratory Birds

The use of the term "migratory" is to describe the legal status of birds. Many migratory are introduced nonindigenous species that never migrate. species that occur at Introduced migratory birds in the area include the cattle egret, house finch (Carpodacus mexicanus), western meadowlark (Sturnella neglecta), northern mockingbird (Mimus polyglottus), common barn owl and northern cardinal (Cardinalis cardinalis). Indigenous birds with migratory status that are truly migratory include the Pacific goldenplover and ruddy turnstone (Arenaria interpres) that are in Hawaii for the winter months but return to the northern arctic zone in the spring. The Newell's shearwater is an indigenous seabird with migratory bird status that is resident to the central Pacific year round, it is found on land during the winter months from mid-December through March. The FWS issues a permit for APHIS-ADC to take migratory birds that create hazards to aircraft. However, except for the introduced cattle egret and common barn owl, APHIS-ADC does not normally take migratory birds. Shooting is the only lethal method of take, and shooting is highly selective. No lethal control would be conducted on other species unless it is determined that it is most effective method for reducing the hazard. Therefore, there are no significant impacts on migratory birds.

Effectiveness of the No Action Alternative

The current program has allowed APHIS-ADC to assist in satisfying the requirement for an ecological study. It satisfies the immediate wildlife hazard management necessary to protect aviation safety, and reduces economic losses from wildlife conflicts. It has also provided technical assistance recommendations toward long term management of the hazards which can best be achieved through the alteration of the attractant ground cover on the airfield. APHIS-ADC, however, does not participate in the maintenance or alteration of the ground cover or other habitat features on or around the airport, therefore the technical assistance effectiveness is dependent on actions by other parties. The no action alternative therefore, satisfies immediate wildlife hazards through direct operational control and monitoring of hazards. The technical assistance recommendations, if implemented will satisfy long term management of the hazards.

Shooting may be ineffective in controlling seed-eating birds (spotted and zebra doves, mannikins, and ring-necked pheasants) at with the existing vegetation (Linnell 1995). APHIS-ADC has recommended sprigging Puerto Rican stargrass and wedelia to discourage airfield use by seed-eating birds. The ecology would be changed but none of

the vegetation in the area is native and small naturalized patches of wedelia already exist throughout the airfield.

Noise Impacts

Impacts on Historic Sites

The wildlife hazard management activities at do not involve any land alterations, consequently there would be no effects on historic sites (State Historic Preservation Division 1996).

Cost of the Program

provides funding for the APHIS-ADC program at the airport. The funds pay for APHIS-ADC technicians and operational expenses. APHIS-ADC policy (APHIS-ADC Directive 2.305) on wildlife hazards to aviation states that such activities will be fully funded by cooperating agencies. If APHIS-ADC were not involved, the cost to the airport to control wildlife hazards at would still continue at or above the same level.

B. No APHIS-ADC Control

In Alternative B, APHIS-ADC would only provide technical assistance to the airport. Without any operational control activities, APHIS-ADC would still provide technical assistance to the airports as mandated by statute and by agreement under the MOU with FAA. Some examples of this would be to continue to provide recommendations to the airport manager on their efforts to eliminate the attractant ground cover or instruct personnel in shooting, trapping, or hazing birds. Propane cannon use would likely continue. The airport personnel or others contracted by the airport to conduct wildlife hazard reductions would implement recommendations proposed by APHIS-ADC. Although many techniques are applicable, the airport would determine which recommendations to carry out or contract. The cost to operate the control activities for the airport would likely remain the same, since additional personnel would have to be hired or contracted to perform the necessary control activities.

Since APHIS-ADC does not have regulatory or managerial jurisdiction, the ultimate environmental affects of technical assistance cannot be fully assessed. APHIS-ADC has no authority beyond making recommendations, however, it could be assumed that negative impacts on target and nontarget species, threatened and endangered species, migratory birds, and animal welfare would be greater without the accountability, national and regional oversight, professionalism, and experience that APHIS-ADC would provide. In a draft Advisory Circular 150/3200, the FAA encourages airport operators to contact wildlife specialists from APHIS-ADC for assistance in resolving wildlife hazards. Immediate and cumulative impacts could not be accurately determined under this alternative. APHIS-ADC would most likely be involved in providing training and recommendations to non-wildlife professionals.

In many situations, technical assistance is effective in reducing wildlife hazards at airports. For example, vegetation management can be effective, however, it is most effective when combined with the full array of management methods. This alternative could make it more difficult for the to provide air travelers and flight personnel with an adequate level of protection. Wildlife damage prevention efforts at the airport would not cease under this alternative, but APHIS-ADC program expertise and techniques would not be readily available to respond to urgent wildlife damage situations arising at the airport. The American public expects a high level of safety protection. Under this alternative, the increased possibilities of aircraft strikes, along with possible threats to human safety and loss of human life, represent serious threats and would not meet the expectations of the American public. Therefore, this is not the preferred alternative.

7. Cumulative Impacts

Cumulative impacts are impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. The scope of this proposal and the number of individual mammals and birds that might be removed in an integrated wildlife management program from a long term perspective would not result in significant cumulative impacts. Because of ongoing contact with state and federal wildlife management agencies, national and local knowledge of wildlife population trends, and mitigation measures used, APHIS-ADC does not have a significant cumulative impact on target species, nontarget species, or sensitive and protected species. This finding is also made on a national level in the APHIS-ADC programmatic EIS.

8. Conclusions

Limitations on the types of methods allowed decreases the effectiveness of actions taken to reduce safety hazards. Because each wildlife damage and hazard situation is unique, many favor the availability of a combination of options to be applied, depending on the factors involved with each individual situation. Such consideration of a full array of available techniques to respond to any one particular case is fundamental to the concept of integrated wildlife damage management.

Alternative A, the current program, provides this full spectrum of control remedies. The employment of APHIS-ADC program personnel at to manage wildlife hazards is necessary to provide expedient, professional, and biologically sound assistance to airport operations. Alternative A provides this with no significant impacts on the human environment. A Finding of No Significant Impact will be issued.

This environmental assessment will be reviewed periodically to assure conformance with current environmental regulations and airport requests and airport wildlife status. Changes in the project scope or changes in environmental regulations may trigger the requirement for a new or revised environmental assessment.

9. Consultations

, Hawaii. Michael A. Linnell Wildlife Biologist - Guam District, USDA-APHIS-ADC, Barrigada Heights, Guam. Biologist, District Supervisor - Hawaii District, USDA-APHIS-James G. Murphy ADC, Honolulu, Hawaii. Tim J. Ohashi Wildlife Biologist, Primary Writer, Assistant State Director, Hawaii, USDA-APHIS-ADC, Honolulu Hawaii. J. Gary Oldenburg Wildlife Biologist, Reviewer, State Director Washington/Hawaii/Alaska/Pacific Islands, Olympia, Washington. . Hawaii. Hawaii. , Hawaii. Margo Stahl Section 7 Coordinator, U.S. Fish and Wildlife Service, Honolulu, Hawaii. Shannon Starratt Environmental Coordinator, Primary Writer/Editor, Environmental Compliance Specialist, USDA-APHIS-ADC, Portland, OR. Tom C. Telfer Wildlife Biologist, District Wildlife Biologist, Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife, Lihue, Kauai, Hawaii. Chairperson and State Historic Preservation Officer, State Historic Mike Wilson Preservation Division, Department of Land and Natural Resources, State of Hawaii. Wildlife Biologist, Reviewer, Assistant State Director for Roger Woodruff Washington/Alaska, Olympia, Washington.

10. References

- Dolbeer, R. A. 1995. Preliminary Analysis of 1994 Data for the United States. (in press) USDA-ADC Denver Wildlife Research Center, Sandusky, OH.
- Federal Aviation Administration. 1988. Federal Aviation Regulations Part 139 Certification and Operations: Land Airports Serving certain Air Carriers. Revised January 1, 1988. U.S. Department of Transportation.
- Hawaii State Historic Preservation Division. 1996. Compliance with Section 106 National Historic Preservation Act, July 11, 1996.
- Hawaii Department of Land and Natural Resources. 1996. Letter of concurrence July 11, 1996. Division of Forestry and Wildlife. Lihue, Kauai, Hawaii.
- Linnell, M.A. 1995. Assessment of Factors Contributing to Bird-Aircraft Collisions at a Tropical Airport and Methods of Prevention. Utah State University, Logan, Utah.
- Linnell, M.A., M.R. Conover and T.J. Ohashi. 1996. Analysis of birdstrikes at a tropical airport. J. Wildl. Manage. 60(4):935-945.
- Tangalin, L. and D. Jamieson. 1992. Report on assessment of rodent activity at Hawaii State Dept. Health, Vector Control Branch. Unpubl. Rep. 19 pp.
- U.S. Department of Agriculture. 1994. Animal and Plant Health Inspection Service, Animal Damage Control. Final Environmental Impact Statement.
- U.S. Department of Agriculture. 1994. Management Information System. 1993-94. Wildlife control data for the USDA-APHIS-ADC. Olympia, Washington.
- U.S. Department of Interior, U.S. Fish and Wildlife Service. 1992. Biological Opinion on the USDA-APHIS-ADC Program.
- U.S. Department of Interior. 1996. Informal Section 7 consultation. U.S. Fish and Wildlife Service. Honolulu, Hawaii.

11. Appendix 1

BIRDS FOUND ON THE AIRFIELD AT



At there are 29 species of birds that generally appear on the airfield at some period through out the year. Of all birds on the airfield, zebra doves, spotted doves, both species of mannikins (although chestnut mannikin are more common), and Pacific golden-plover comprise the highest percentage of birdstrikes, primarily because of their behavioral patterns, population densities, and dietary preferences. Some of the larger species of birds such as the common barn owl, pueo (short-eared owl), ring-necked pheasant, cattle egret, Hawaiian duck (koloa) all of which have been implicated in birdstrikes, may cause the most damage to aircraft merely because of their large size.

SEED-EATING BIRDS

Zebra dove (Geopelia striata)

Spotted dove (Streptopelia chinensis)
Chestnut mannikin (Lonchura malacca)
Nutmeg mannikin (Lonchura punctulata)
House finch (Carpodacus mexicanus)

WATERBIRDS

++ Pacific golden-plover (Pluvialis fulva) ++ Ruddy turnstone (Arenaria interpres) +* Hawaiian duck (Koloa) (Anas wyvilliana)

+* Black-necked stilt (Himantopus mexicanus knudseni)

++ Bristle-thighed Curlew (Numenius tahitiensis)

Cattle egret (Bubulcus ibis)

UPLAND BIRDS

+* Hawaiian goose (Nene) (Nesochen sandvicensis)

+ Short-eared owl (Pueo) (Asio flammeus sandwichensis)

Common barn owl
Ring-necked pheasant (Phasianus colchicus)
Western meadowlark
Red jungle fowl
(Gallus gallus)

URBAN BIRDS

Common myna (Acridotheres tristis)
House sparrow (Passer domesticus)
Java sparrow (Padda oryzivora)
Red-crested cardinal (Paroaria coronata)
Northern cardinal (Cardinalis cardinalis)
Northern mockingbird (Mimus polyglottus)

MARINE BIRDS

+** Newell's shearwater

++ Wedgetailed shearwater

++ Laysan albatross

++ Great frigatebird ('Iwa)

++ Red-tailed tropicbird

++ Red-footed booby

+ endemic

++ indiginous

* endangered

** threatened

(Puffinus newelli)

(Puffinus pacificus)

(Diomedea immutabilis

(Fregata minor palmerstoni)

(Phaethon rubicauda rothschildi)

(Sula sula rubripes)

12. Appendix 2

PLANTS ON THE AIRFIELD AT

The foremost problem on the airfield of the with regard to bird populations is the large diversity of seed producing plants. At present, there are 18 grasses and 48 broadleaf species that have been identified on the airfield, and there are probably more. Most of these plants produce edible seeds at some point in their lifecycle, virtually guaranteeing a year round supply of food in one form or another for many species of birds, particularly the seed eaters. In addition to food resources, the diversity of plants provide harborage and cover for birds, as well as offering a wide range of habitats for insects and other invertebrates which then attract insectivorous birds and rodents. Consequently, has been plagued with birdstrikes involving a wide variety of bird species and various type of aircraft.

POACEAE (GRASS FAMILY)

Pitted beardgrass (Andropogon pertuses) (Cenchrus echinatus) Sandur Swollen fingerergrass (Chloris infalata) Bermuda grass (Cynodon dactylon) Puerto Rican stargrass (Cynodon nlemfunsis) (Digitaria adscendens) Henry's crabgrass Wiregrass, Goosegrass (Eulinsine indica) Molasses grass (Melinis minutiflora) Guinea grass (Pancium maximum) Hilo grass (Paspalum conjugatum) Rice grass (Paspalum orbiculare) (Rhynchelytrum repens) Natal redtop

(Seteraia glauca) Yellow foxtail, bristlegrass (Sporobulus indicus) Smutgrass (Tricachne insularis) Sour grass California grass (Brachiaria mutica) **Eragrostis** (Eragrostis spp.)

Sprangletop (Leptochloa uninervia)

CYPERACEAE (SEDGE FAMILY)

Kili'o'opu (Kyllinga nemoralis) Purple nutsedge (Cyperus rotundus)

BORAGINACEAE (BORAGE FAMILY)

Heliotrope (Heliotropium procumbens)

COMMELINACEAE (SPIDERWORT FAMILY)

Honohono, Day flower (Commelina diffusa)

AMARANTHACEAE (AMARANTH FAMILY)

Spiny amaranth (Amaranthus spinosis)

PHYTOLACCACEAE (POKEWEED FAMILY)

Phytolacca, Pokeweed (Phytolacca octandra)

PORTULACEAE (PURSLANE FAMILY)

Purslane, Pigweed (Portulaca oleracea)

CRUCIFERAE (MUSTARD FAMILY)

Swinecress, Swine watercress (Coronopus didymus

FABACEAE (PEA FAMILY)

Japanese tea (Cassia leschenaultiana) Fuzzy rattle pod (Crotalaria incana) Indigo (Indigofera suffruticosa) (Leucaena leucocephala) Haole koa, Ekoa (Mimosa pudica)

Sensitive plant, hilahila

Alfalfa (Medicago setiba)

Black medick (Medicago spp.)

Bur clover (Medicago polymorpha) (Desmanthus virgatus) Slender mimosa Wildbean, Cow pea (Macroptilium lathyroides)

EUPHORBIACEAE (SPURGE FAMILY)

Graceful spurge (Chamaesyce hypericifloia)

Garden spurge (Chamaesyce hirta) Niruri (Phyllanthus debilis) (Ricinus communis) Castor bean

MALVACEAE (HIBISCUS FAMILY)

False mallow (Malavastrum coromandelianum)

Ilima lei (Sida cordifolia) (Sida spinosa) Prickly sida

STERCULIACEAE (COCOA FAMILY)

'Uhaloa (Waltheria indica)

PASSIFLORACEAE (PASSION FLOWER FAMILY)

Scarlet-fruited passion flower (Passiflora foetida)

CONVOLVULACEAE (MORNING GLORY FAMILY)

Morning glory (Ipomea obscura) **UNBELLIFERAE (PARSLEY FAMILY)**

Asiatic pennywort (Centella asiatica)

VERBENACEAE (VERVAIN FAMILY)

Lantana (Lantan camara)

Jamaica vervain (Stachytarpheta jamaicensis)

SOLONACEAE (TOMATO FAMILY)

Popolo (Solanum nigrum)

RUBIACEAE (COFFEE FAMILY)

Buttonweed (Borreria laevis)

CUCURBITACEAE (GOURD FAMILY)

Balsam apple, Peria (Momordica charantia)

ASTERACEAE (SUNFLOWER FAMILY)

Spanish needle, Beggar tick (Bidens pilosa) False daisy (Eclipta alba)

Floras paintbrush, Red pualele
Hairy horseweed
(Emilia sonchifolia)
(Erigeron bonariensis)
Hairy cats-ear
(Hypochoeris radicata)

Indian fleabane (Pluchea indica)

Dandelion (Taraxacum officinale)
Asiatic hawksbeard (Youngia japonica)
Golden crown-beard (Verbesina encelioides)
Wedelia (Wedelia trilobata)
Pualele, Sow thistle (Sonchus oleraceus)

TWO UNIDENTIFIED SPECIES